(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: 0 327 317 A2

(12) EUROPEAN PATENT APPLICATION

(21) Application number: 89300940.7

(22) Date of filing: 31.01.89

(51) Int. Cl.4: D 04 H 5/06

(30) Priority: 02.02.88 JP 22319/88

(43) Date of publication of application: 09.08.89 Bulletin 89/32

(84) Designated Contracting States: DE FR GB

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(54) Bulky reinforced non-woven fabric.

(57) A bulky reinforced non-woven fabric comprises (i) a web comprising 30 to 100% by weight of hot-melt-adhesive fibers and 70 to 0% by weight of fibers having a melting point above that of the hot-melt-adhesive component of the hot-melt-adhesive fibers and (ii) monofilaments; the fibers constituting the web being adhered to one another and the fibers constituting the web and the monofilaments also being adhered together through hot-melt adhesion and the non-woven fabric having wrinkles, generated by heat shrinkage of the monofilaments, of a wavelength in terms of the distance between adjacent wrinkles of 0.1 to 20 mm, over the surface of the non-woven fabric.

The fabric may be prepared by arranging monofilaments having a percentage shrinkage of 20% or higher under heat treatment conditions for melt-adhering the hot-melt-adhesive fibers over the surface of an appropriate web; adhering the fibers constituting the web to one another and also to the monofilaments by hot-melt-adhesion; and at the same time causing the web to shrink by shrinkage of the monofilaments.

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Description

Bulky reinforced non-woven fabric

This invention relates to a non-woven fabric produced by a hot-melt adhesion process and having improved bulkiness and strength.

Known processes for producing non-woven fabrics using hot-melt adhesive fibers include the heated roll process, the hot-air-blowing process, etc., and non-woven fabrics having a basis weight of 15 to 200 g/m^2 have been used as surface materials for disposale diaper interlining fabrics, disposable clothes, etc.

However, non-woven fabrics produced by conventional processes have generally been in the form of thin flat sheets, of inadequate bulkiness and strength. In order to improve the strength of non-woven fabrics, if the temperature and pressure at the time of heat treatment are raised, the non-woven fabrics become thinner and stiffer so that bulkiness is lost. Processes for improving the strength of non-woven fabrics by incorporating reinforcing fibers thereinto are disclosed in JP-A-61-41357/1986 or JP-A-62-215057/1987, but even according to these processes, it is not possible to improve the bulkiness of the non-woven fabrics.

As a process for imparting bulkiness to non-woven fabrics having a low basis weight, it has been proposed to provide crepe-like lateral wrinkles on non-woven fabrics by peeling non-woven fabrics from a drum employing a doctor knife in a suction drum dryer process. However, non-woven fabrics obtained by this process, have improved bulkiness, but they are easily elongated by slight tension in the longitudinal direction and liable to be deformed.

In accordance with a first embodiment of the invention there is provided a bulky reinforced non-woven farbic composed of (i) a web comprising 30 to 100% by weight of hot-melt-adhesive fibers and 70 to 0% by weight of fibers having a melting point above that of the hot-melt-adhesive component of the hot-melt-adhesive fibers, and (ii) monofilaments; the fibers constituting the web being adhered to one another and the fibers constituting the web and the monofilaments also being adhered together through hot-melt adhesion, and the non-woven fabric having wrinkles, generated by heat shrinkage of the monofilaments, of a wavelength in terms of a distance between adjacent wrinkles, of 0.1 to 20 mm, over the whole surface of the non-woven fabric.

The invention also provides a process for producing a bulky reinforced non-woven fabric, which process comprises arranging over the surface of a web comprising 30 to 100% by weight of hot-melt-adhesive fibers and 70 to 0% by weight of fibers having a melting point above that of the hot-melt-adhesive component of the hot-melt-adhesive fibers, monofilaments having a percentage shrinkage of 20% or more under heat treatment conditions for melt-adhering the hob-melt-adhesive fibers; adhering the fibers constituting the web to one another and also adhering the monofilaments to fibers constituting the web by hot-melt adhesion; and also causing the web to shrink by shrinkage of the monofilaments.

The hot-melt-adhesive fibers used in the present invention refer to homogeneous fibers consisting of thermoplastic resins such as polyethylene, crystalline polypropylene, low-melting polyesters, etc. or composite fibers consisting of thermoplastic resins having different melting points such as crystalline polypropylene/polyethylene, polyester/polyethylene, polyester/low-melting polyester, etc., these homogeneous or composite fibers generating hot-melt-adhesive properties through heat treatment. The fineness thereof has no particular limitation, but usually those of 1.5 to 30 d/f (denier/filament) are used depending on the required properties for particular use of non-woven fabrics.

In the case where the hot-melt-adhesive fibers are homogeneous fibers, the whole of the fibers is a hot-melt-adhesive component and there is a fear that the fibers melt depending on heat treatment conditions to lose the fiber shape; hence it is preferred to prepare a web blending the hot-melt-adhesive fibers with other fibers having a melting point higher than the above heat treatment temperature.

In the case where the hot-melt-adhesive fibers are composite fibers composed of thermoplastic resins having different melting points, it is possible to subject the fibers to heat treat melting lower-melting thermoplastic resin component alone as the hot-melt-adhesive component. Thereby it is possible to prepare the web from the composite fibers alone, but if desired, it is also possible to prepare the web by blending the hot-melt-adhesive fibers with other fibers having melting points higher than that of the above-mentioned lower-melting thermoplastic resin. Such other fibers used in admixture with these hot-melt-adhesive fibers will often be abbreviated to higher-melting fibers.

Examples of such higher-melting fibers are natural fibers such as cotton, hemp, wool, etc., and man-made fibers such as nylons, polyesters, rayon, etc., and these fibers may be blended in the web up to at most 70% by weight. If the content of the hot-melt-adhesive fibers in the web is less than 30% by weight, the melt-adhered points between the fibers are reduced to lower the strength of the non-woven fabric or increase occurrence of fluffs.

The above-mentioned hot-melt-adhesive fibers or the blend thereof with the higher-melting fibers is made up into a web having a desired basis weight by means of a so far known carding machine or random webber. It is possible to subject the resulting web to heat treatment as it is, but it is preferred to expose it at a temperature close to the melting point of the hot-melt-adhesive component of the hot-melt-adhesive fibers for a short time to cause adhered points to generate between fibers in advance (this process will often be abbreviated to pretreatment), since this pretreatment is able to stabilize the shape of the web and to exert the shrinkage of the

monofilaments evenly over the whole of the web. For the pretreatment, any of known means such as infrared heating, hot air heating, heated rolls, etc. may be employed.

The monofilaments used in the present invention refer to those having a percentage of shrinkage of 20% or higher under heat treatment conditions for converting the web into a non-woven fabric and can be obtained by stretching unstretched monofilaments prepared by melt-spinning thermoplastic resins at a low stretching ratio of 1.5 to 2.5 times the original length at a relatively low temperature in the vicinity of room temperature. Further, when the thermoplastic resins used have a broad molecular weight distribution, monofilaments having a high percentage of shrinkage are easily obtained. The fineness of such monofilaments has no particular limitation, but usually those of 30 d/f or more are preferably used since it is necessary to exert the shrinking force thereof as far as the web. Further, it is preferred for the monofilaments to use a stock having a good adhesion to the hot-melt-adhesive fibers in the web, and it is also preferred to use thermoplastic resins of the same kind as that of the hot-melt-adhesive fibers (or the lower-melting resins thereof in the case of composite fibers).

The monofilaments are arranged uniformly over the whole surface of the web. As the arrangement pattern, the following are illustrated: two groups of the monofilaments are arranged in the length direction of the web and in the direction perpendicular thereto, respectively, to make a lattice pattern, or arranged each in the direction oblique to the length direction crossing manner in which the two groups are crossed to each other to make a diamond pattern, or the monofilaments are arranged parallel in one direction to make a stripe pattern. In any cases, the monofilaments are arranged so as to give a density of 1 to 20 monofilaments/25 mm. The monofilaments may be arranged either on one surface of the web or on both the surfaces thereof and further may also be arranged inside the web.

The web having the monofilaments arranged is heat treated at the melt-adhesion temperature of the hot-melt-adhesive fibers or higher to integrate the monofilaments with the web. As the means for the heat treatment, known means such as hot air heating, heated rolls, etc. may be employed, but in order to ensure adhesion of the monofilaments to the web and also to cause the monofilaments to shrink sufficiently, two-stage heating employing contact bonding on heating by means of heated nip rolls and hot air heating under non-tension is preferred.

When the web containing the hot-melt-adhesive fibers are heat treated, the fibers constituting the web are bonded to one another to convert the web into a non-woven fabric, and at the same time, heat shrinkage generated in the monofilaments causes the web to shrink. Since this shrinkage is not due to shrinkage of the fibers themselves constituting the web, the resulting non-woven fabric becomes bulky; its surface has wrinkles of a wavelength of 0.1 to 20 mm over the whole surface; and these wrinkles do not extend even when tension is applied to the non-woven fabric. Further, due to the reinforcing effect brought about by the monofilaments, the non-woven fabric has a high strength.

The present invention will be described in more detail by way of Examples.

Example 1

Composite fibers (hot-melt-adhesive fibers)(80% by weight) obtained by melt-spinning a crystalline polypropylene (m.p.: 163°C) together with a high density polyethylene (m.p.: 135°C) in a composite ratio of 50/50 in side-by-side type, and having a fineness of 3 deniers and a fiber length of 64 mm were blended with rayon (2 deniers, 51 mm) (20% by weight), followed by carding the resulting blended fibers to prepare a web, and subjecting this web to pretreatment by means of a hot-air-passing heater at 140°C for 1.5 minute. The web after the pretreatment had a basis weight of 30 g/m^2, a longitudinal strength of 4,500 g/5 cm, a lateral strength of 800 g/5 cm and an elongation at breake of 41%. In addition, the strengths were measured according to JIS L 1085 (testing method for non-woven inter-lining fabrics).

A random terpolymer (softening point: 110°C and m.p.: 140°C) consisting of ethylene/propylene/butene-1 (3.5/92.0/4.5% by weight, respectively) and a high density polyethylene (softening point: 110°C and m.p.: 135°C) were subjected to composite spinning in a composite ratio of 50/50 in side-by-side type, followed by water cooling to obtain unstretched composite monofilaments, and stretching the monofilaments to 1.5 times the original length at room temperature to obtain monofilaments having a fineness of 220 deniers. When the monofilaments were heated at 140°C for one minute, the resulting monofilaments had a percentage of shrinkage of 45% and a strength after shrinkage of 3.2 g/d.

The monofilaments were arranged between two sheets of the above-mentioned pretreated webs at a density of 4.2 monofilaments/25 mm both in the longitudinal direction and in the lateral direction, followed by preliminarily contact-bonding the whole by means of heated calender rolls of 135°C under a liner pressure of 20 Kg/cm and at a speed of 15 m/min, and successively subjecting the resulting material to heat treatment by means of a hot-air-passing-through type heater at 145°C under non-tension state for one minute and 50 seconds to obtain a bulky non-woven fabric. This bulky non-woven fabric had wrinkles of a wavelength (distance between adjacent wrinkles) of about 1.5 mm over the whole surface thereof, a thickness of 1.5 mm, a break strength of 13,090 g/5 cm in the longitudinal direction, that of 4,805 g/5 cm in the lateral direction, an elongation at breake of 61% in the longitudinal direction and that of 68% in the lateral direction.

Comparative example 1

Two sheets of the web after pretreatment used in Example 1 were placed on each other, followed by heated calender rolls treatment and heat treatment by means of a hot-air-passing-through type heater as in the case of Example 1 to obtain a non-woven

fabric, and in this example, no monofilament was used. The resulting non-woven fabric had a thickness of 0.3 mm, a break strength of 8,200 g/5 cm in the longitudinal direction, that of 1,200 g/5 cm in the lateral direction, an elongation at breake of 42% in the longitudinal direction and that of 48% in the lateral direction.

Example 2

Composite fibers (hot-melt-adhesive fibers) of a fineness of 2.5 deniers and a fiber length of 64 mm, obtained by melt-spinning a crystalline polypropylene (m.p.: 163°C) as the core component thereof and a high density polyethylene (m.p.: 135°C) as the sheath component thereof in a composite ratio of 50/50 were carded into a web, followed by subjecting the web to pretreatment by means of a hot-air-passing-through type heater at 140°C for 1.5 minute. The resulting web after pretreated had a basis weight of 20 g/m^2 and a thickness of 0.2 mm.

A random copolymer (MFR: 8, softening point: 130°C and m.p.: 145°C) consisting of ethylene and propylene (2.5/97.5% by weight, respectively) was singly melt-spun, followed by water cooling, stretching the resulting unstretched monofilaments to 2.0 times the original length at room temperature to obtain monofilaments having a fineness of 30 deniers. When the monofilaments were heat treated at 135°C for one minute, the resulting monofilaments had a percentage of shrinkage of 51% and a tenacity after shrinkage of 4.9 g/d.

The monofilaments were arranged on the upper surface of the above-mentioned pretreated webs at a density of 3 monofilaments/25 mm only in the longitudinal direction, followed by preliminarily contact-bonding the whole by means of heated calender rolls of 135°C under a linear pressure of 10 Kg/cm and a rate of 8 m/min. and successively subjecting the resulting material to heat treatment by means of a hot-air-passing-through type heater at 140°C under non-tension state for one minute and 10 seconds to obtain a bulky non-woven fabric. This bulky non-woven fabric had lateral wrinkles of a wavelength (distance between adjacent wrinkles) of about 1.5 mm, a thickness of 0.9 mm, a break strength of 3,950 g/5 cm in the longitudinal direction, that of 1,020 g/5 cm in the lateral direction, an elongation at breake of 42% in the longitudinal direction and that of 50% in the lateral direction.

Comparative example 2

The web after pretreatment used in Example 2 was subjected to heated calender rolls treatment and heat treatment by means of a hot-air-passing-through type heater as in the case of Example 2 to obtain a non-woven fabric and in this example, no monofilament was used. The resulting non-woven fabric had a thickness of 0.15 mm, a break strength of 2,650 g/5 cm in the longitudinal direction, that of 465 g/5 cm in the lateral direction, an elongation at breake of 46% in the longitudinal direction and that of 54% in the lateral direction.

Claims

1. A bulky reinforced non-woven fabric composed of (i) a web comprising 30 to 100% by weight of hot-melt-adhesive fibers and 70 to 0% by weight of fibers having a melting point above that of the hot-melt-adhesive component of the hot-melt-adhesive fibers and (ii) monofilaments; the fibers constituting the web being adhered to one another and the fibers constituting the web and the monofilaments also being adhered together through hot-melt adhesion and the non-woven fabric having wrinkles, generated by heat shrinkage of the monofilaments, of a wavelength in terms of the distance between adjacent wrinkles of 0.1 to 20 mm, over the surface of the non-woven fabric.

2. A non-woven fabric according to claim 1 in which the hot-melt-adhesive fibers are homogeneous polyethylene, polypropylene or polyester fibers; or composite crystalline polypropylene/polyethylene, polyester/polyethylene or polyester/low-melting polyester fibers.

3. A non-woven fabric according to claim 1 or claim 2 in which the monofilaments consist of thermoplastic resin of the same kind as the hot-melt adhesive fibers.

4. A non-woven fabric according to any one of the preceding claims in which the monofilaments are arranged uniformly over the surface of the web at a density of 1 to 30 monofilaments /25 mm length of the web.

5. A process for producing a bulky reinforced non-woven fabric, which process comprises arranging over the surface of a web comprising 30 to 100% by weight of hot-melt-adhesive fibers and 70 to 0% by weight of fibers having a melting point above that of the hot-melt-adhesive component of the hot-melt-adhesive fibers, monofilaments having a percentage shrinkage of 20% or more under heat treatment conditions for melt-adhering the hot-melt adhesive fibers; adhering the fibers constituting the web to one another and also adhering the fibers constituting the web to the monofilaments by hot-melt adhesion; and also causing the web to shrink by shrinkage of the monofilaments.

6. A process according to claim 5 in which the hot-melt-adhesive fibers and/or the monofilaments are as defined in claim 2 and/or claim 3.

7. A process according to claim 5 or claim 6 in which the monofilaments are obtained by stretching unstretched monofilaments prepared by melt-spinning thermoplastic resins at a stretch ratio of 1.5 to 2.5 times their original length at room temperature.